Fig. 1

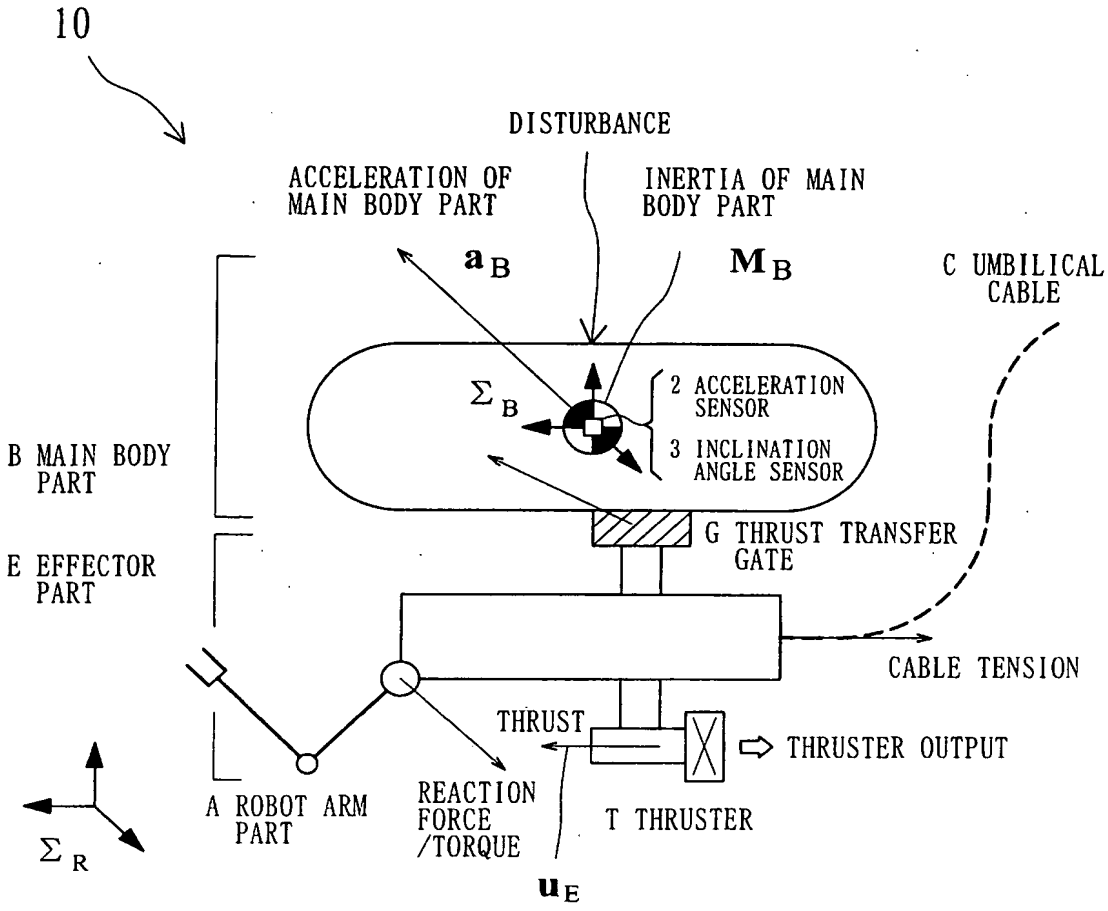

10
DISTURBANCE
ACCELERATION OF MAIN BODY PART
INERTIA OF MAIN BODY PART
a_B
M_B
C UMBILICAL CABLE
Σ_B
2 ACCELERATION SENSOR
3 INCLINATION ANGLE SENSOR
B MAIN BODY PART
G THRUST TRANSFER GATE
E EFFECTOR PART
CABLE TENSION
THRUST
THRUSTER OUTPUT
A ROBOT ARM PART
REACTION FORCE /TORQUE
T THRUSTER
Σ_R
u_E

Fig. 2

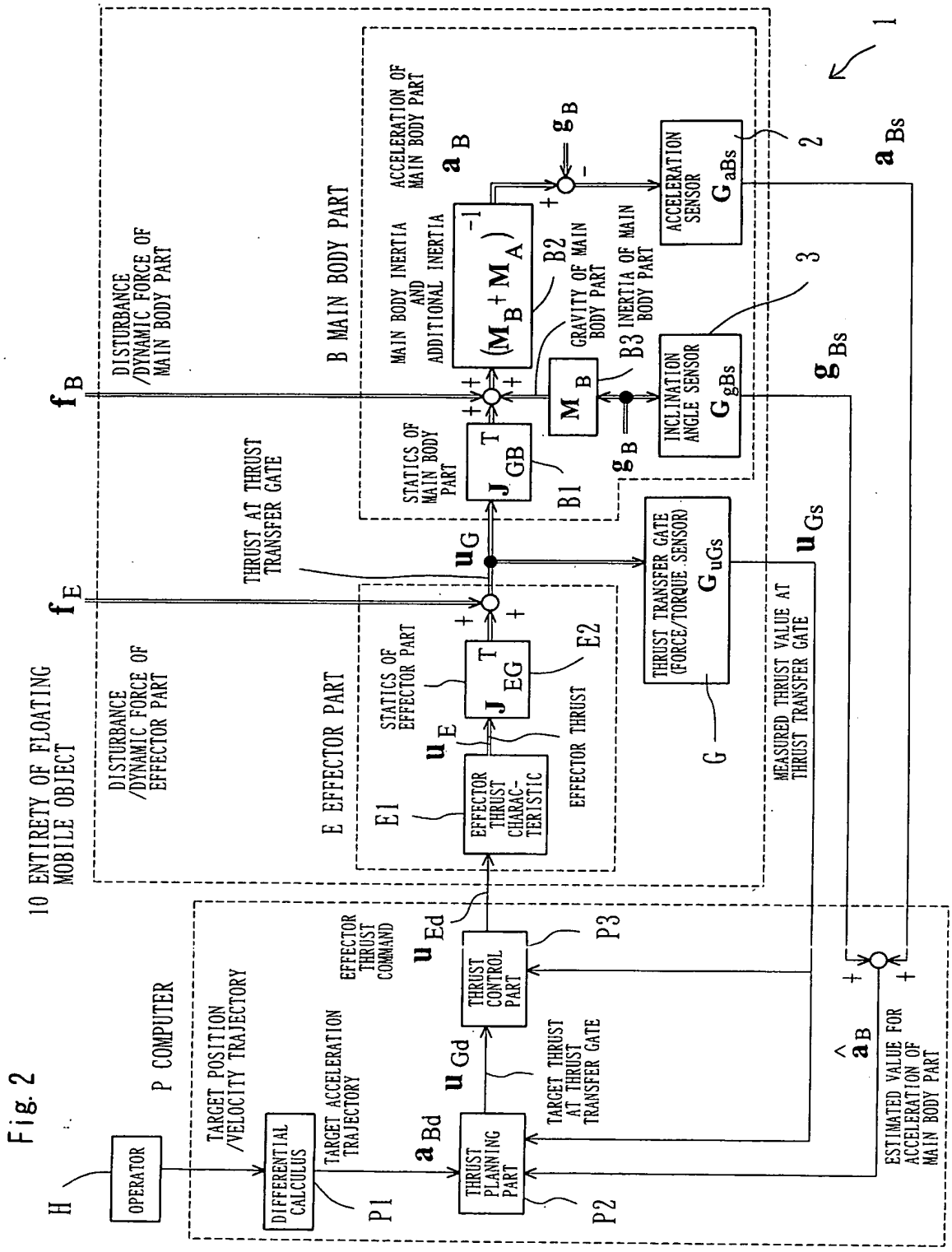
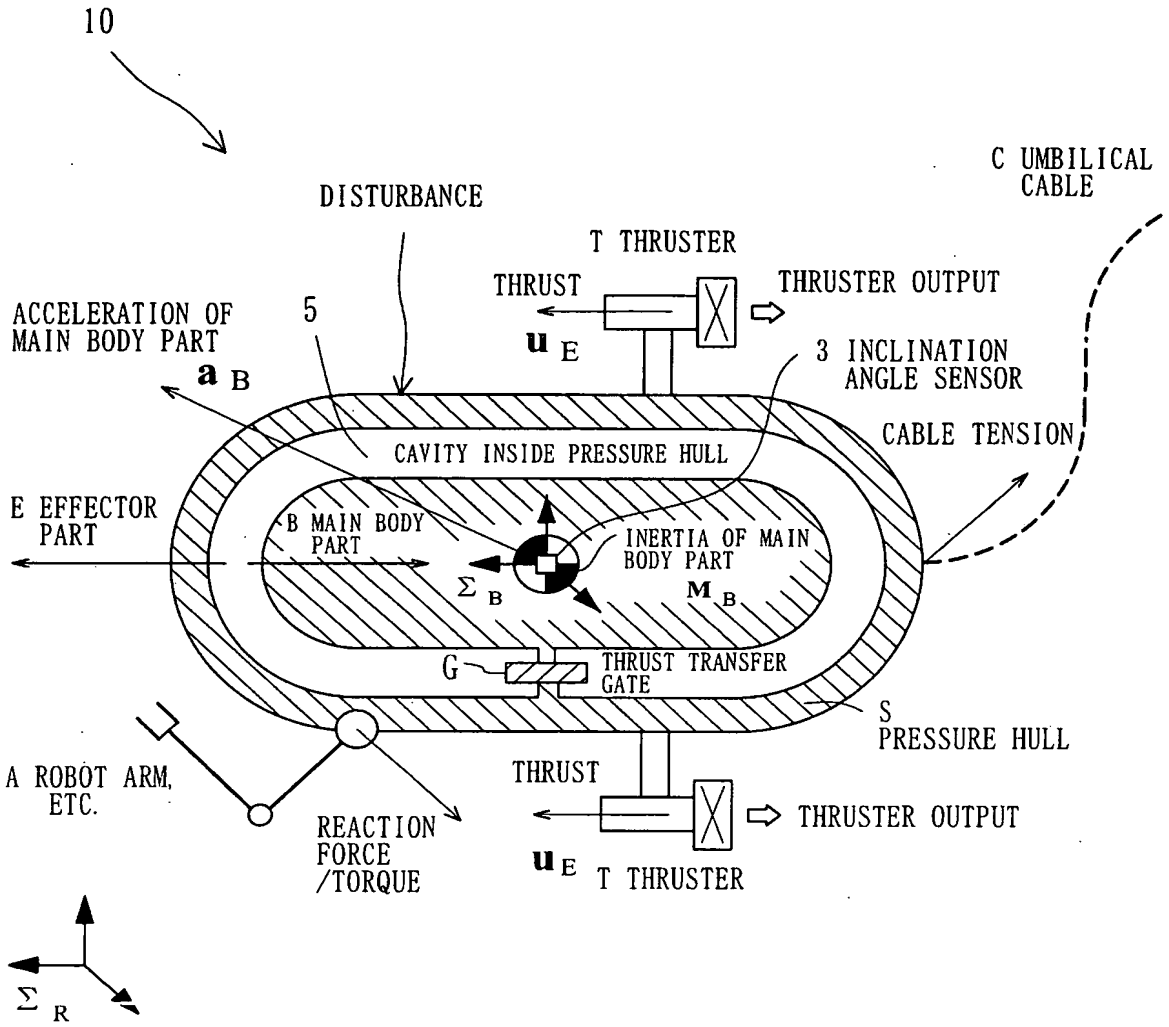

1
10 ENTIRETY OF FLOATING MOBILE OBJECT
DISTURBANCE /DYNAMIC FORCE OF MAIN BODY PART
DISTURBANCE /DYNAMIC FORCE OF EFFECTOR PART
B MAIN BODY PART
E EFFECTOR PART
THRUST AT THRUST TRANSFER GATE
STATICS OF MAIN BODY PART
STATICS OF EFFECTOR PART
MAIN BODY INERTIA AND ADDITIONAL INERTIA
ACCELERATION OF MAIN BODY PART
GRAVITY OF MAIN BODY PART
B3 INERTIA OF MAIN BODY PART
ACCELERATION SENSOR
INCLINATION ANGLE SENSOR
THRUST TRANSFER GATE (FORCE/TORQUE SENSOR)
MEASURED THRUST VALUE AT THRUST TRANSFER GATE
EFFECTOR THRUST CHARACTERISTIC
EFFECTOR THRUST
P COMPUTER
TARGET POSITION /VELOCITY TRAJECTORY
TARGET ACCELERATION TRAJECTORY
EFFECTOR THRUST COMMAND
TARGET THRUST AT THRUST TRANSFER GATE
ESTIMATED VALUE FOR ACCELERATION OF MAIN BODY PART
OPERATOR
DIFFERENTIAL CALCULUS
THRUST PLANNING PART
THRUST CONTROL PART
H
P1
P2
P3
E1
E2
B1
B2
B3
G
2
3

Fig. 3


10
C UMBILICAL CABLE
DISTURBANCE
T THRUSTER
THRUST
THRUSTER OUTPUT
ACCELERATION OF MAIN BODY PART
$\mathbf{a}_B$
5
$\mathbf{u}_E$
3 INCLINATION ANGLE SENSOR
CABLE TENSION
CAVITY INSIDE PRESSURE HULL
E EFFECTOR PART
B MAIN BODY PART
INERTIA OF MAIN BODY PART
Σ_B
$\mathbf{M}_B$
G
THRUST TRANSFER GATE
S
PRESSURE HULL
A ROBOT ARM, ETC.
REACTION FORCE /TORQUE
THRUST
THRUSTER OUTPUT
$\mathbf{u}_E$
T THRUSTER
Σ_R

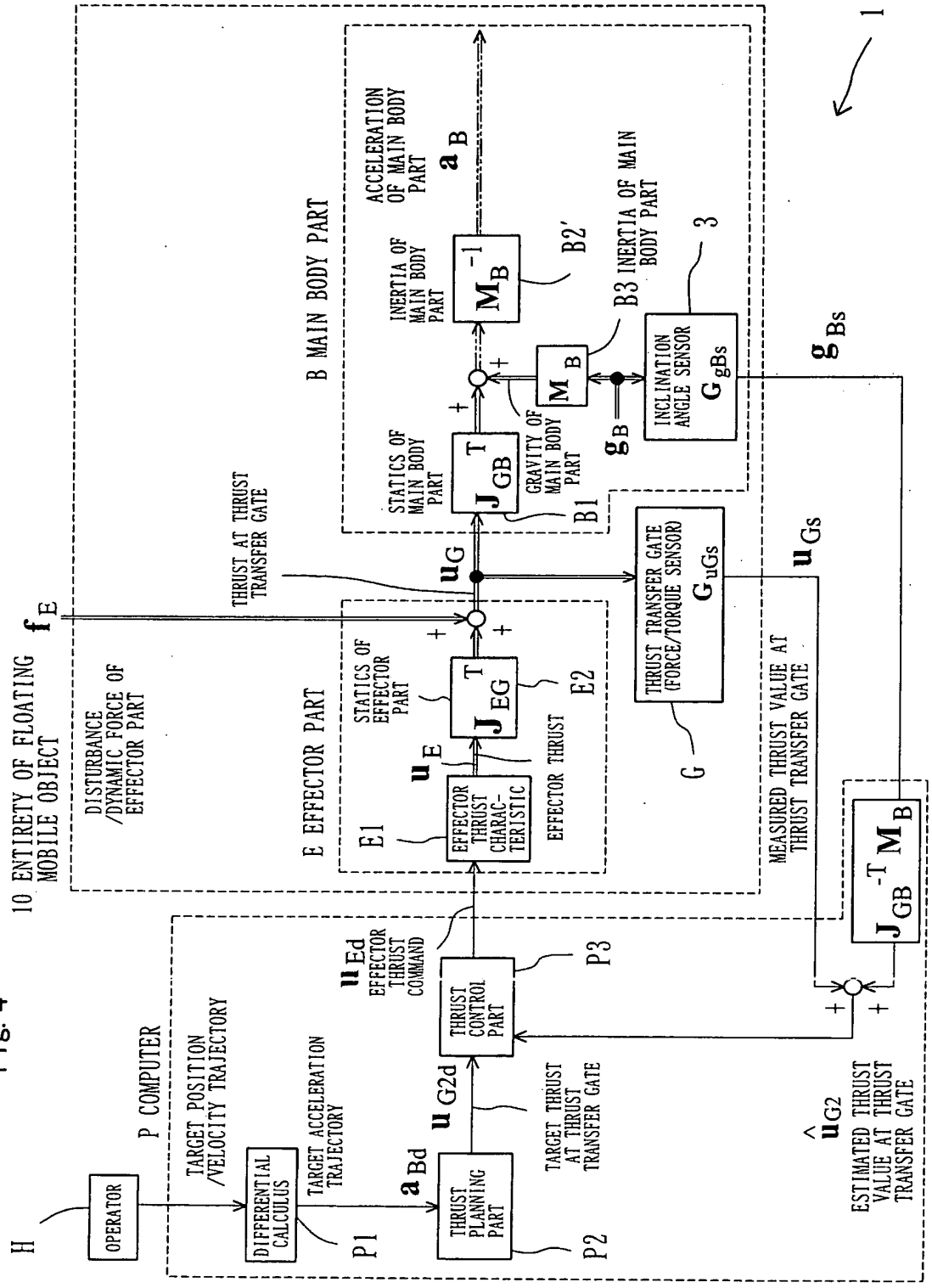
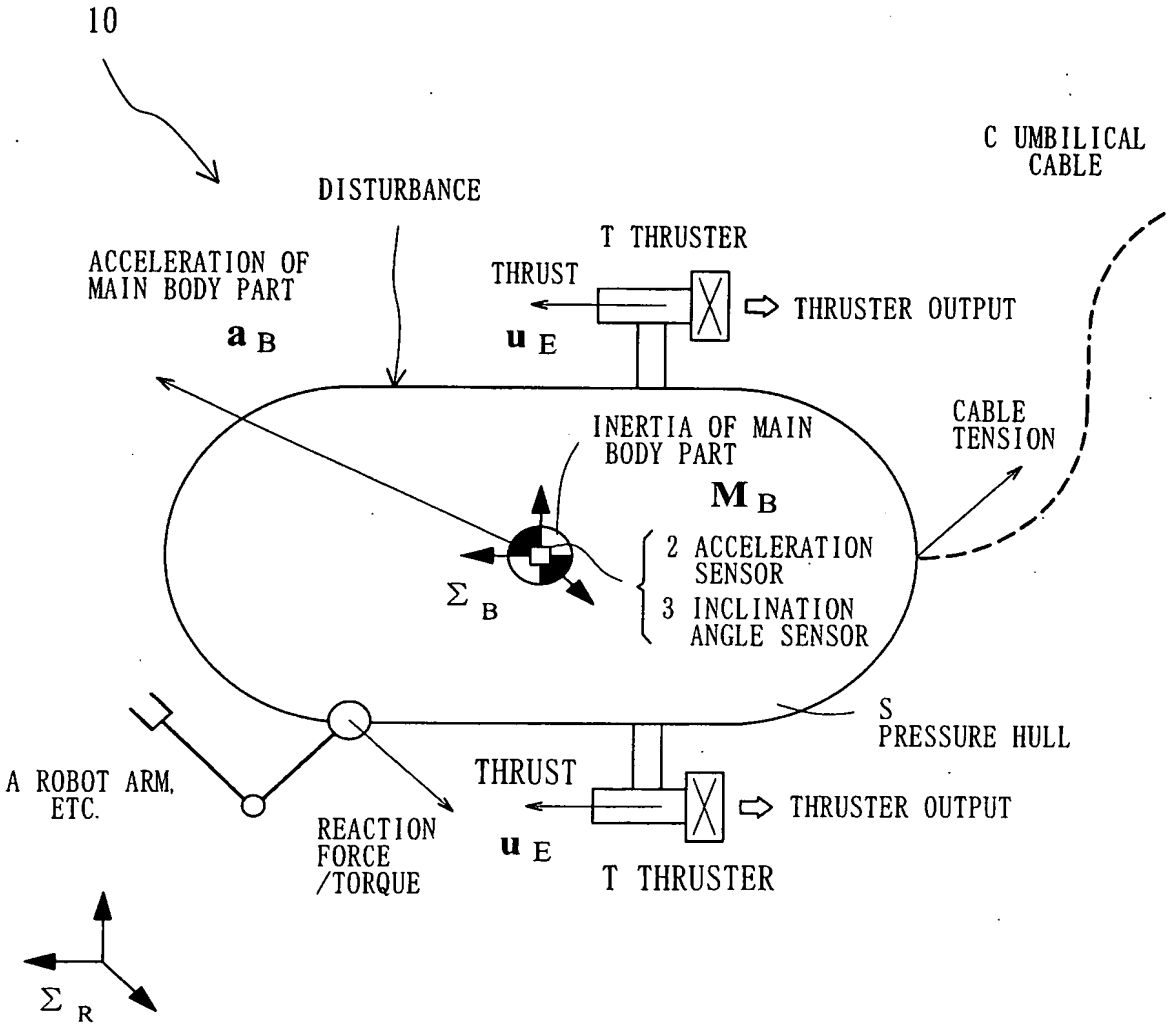

1
10 ENTIRETY OF FLOATING MOBILE OBJECT
DISTURBANCE /DYNAMIC FORCE OF EFFECTOR PART
f_E
B MAIN BODY PART
ACCELERATION OF MAIN BODY PART
a_B
INERTIA OF MAIN BODY PART
M_B^{-1}
B2'
B3 INERTIA OF MAIN BODY PART
3
M_B
g_B
INCLINATION ANGLE SENSOR
G_{gBs}
g_{Bs}
STATICS OF MAIN BODY PART
J_{GB}^T
GRAVITY OF MAIN BODY PART
B1
THRUST AT THRUST TRANSFER GATE
u_G
THRUST TRANSFER GATE (FORCE/TORQUE SENSOR)
G_{uGs}
G
u_{Gs}
MEASURED THRUST VALUE AT THRUST TRANSFER GATE
E EFFECTOR PART
STATICS OF EFFECTOR PART
J_{EG}^T
E2
u_E
E1
EFFECTOR THRUST CHARAC-TERISTIC
EFFECTOR THRUST
$J_{GB}^{-T} M_B$
u_{Ed}
EFFECTOR THRUST COMMAND
THRUST CONTROL PART
P3
P COMPUTER
TARGET POSITION /VELOCITY TRAJECTORY
DIFFERENTIAL CALCULUS
TARGET ACCELERATION TRAJECTORY
P1
a_{Bd}
u_{G2d}
THRUST PLANNING PART
TARGET THRUST AT THRUST TRANSFER GATE
P2
$\hat{u}_{G2}$
ESTIMATED THRUST VALUE AT THRUST TRANSFER GATE
H
OPERATOR

Fig. 4

Fig. 5


10
C UMBILICAL CABLE
DISTURBANCE
T THRUSTER
ACCELERATION OF MAIN BODY PART
$\mathbf{a}_B$
THRUST
$\mathbf{u}_E$
THRUSTER OUTPUT
CABLE TENSION
INERTIA OF MAIN BODY PART
$\mathbf{M}_B$
2 ACCELERATION SENSOR
3 INCLINATION ANGLE SENSOR
Σ_B
S
PRESSURE HULL
A ROBOT ARM, ETC.
REACTION FORCE /TORQUE
THRUST
$\mathbf{u}_E$
THRUSTER OUTPUT
T THRUSTER
Σ_R

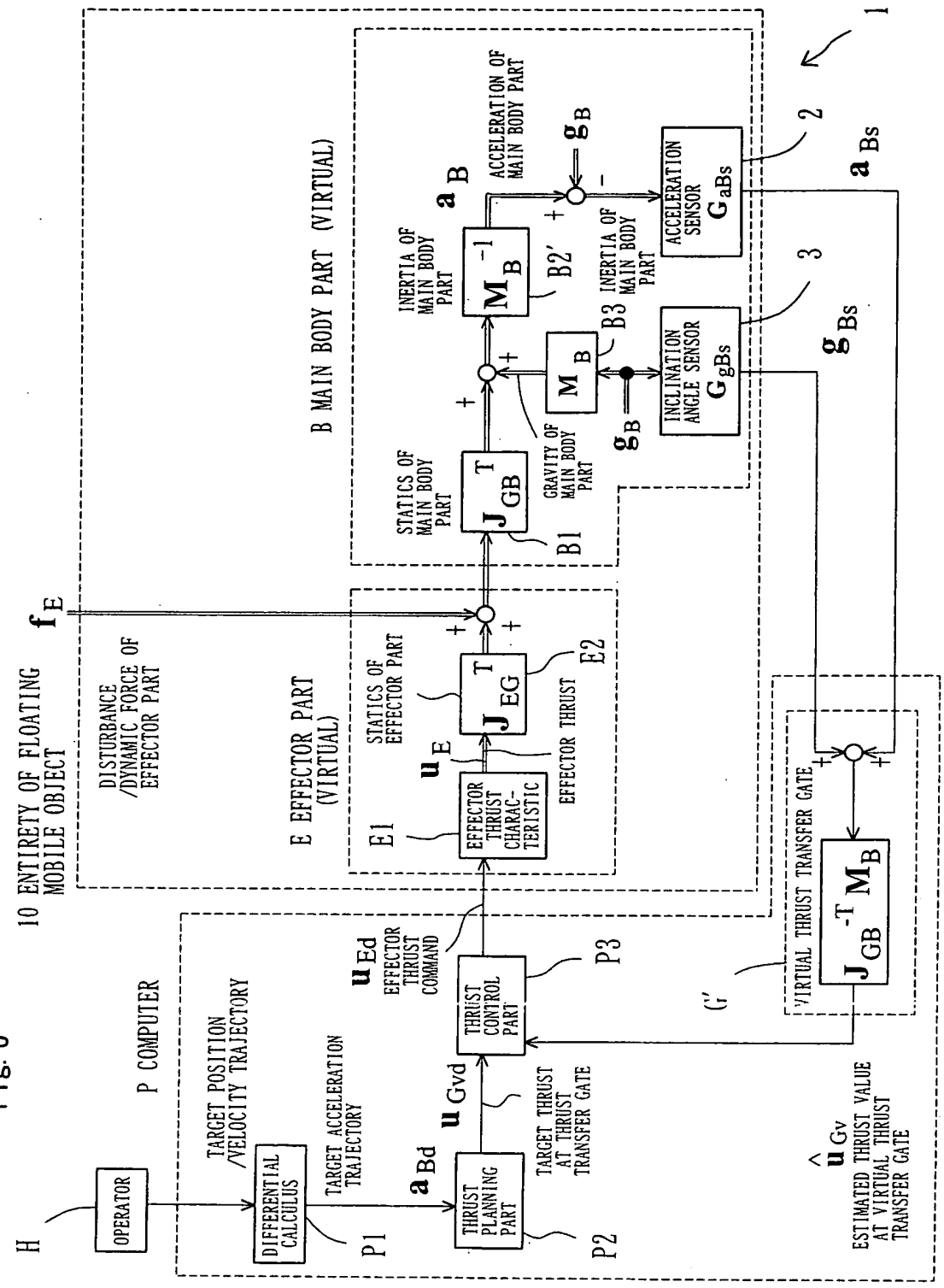

1
2
3
10 ENTIRETY OF FLOATING MOBILE OBJECT
DISTURBANCE /DYNAMIC FORCE OF EFFECTOR PART
f_E
B MAIN BODY PART (VIRTUAL)
E EFFECTOR PART (VIRTUAL)
STATICS OF MAIN BODY PART
J_{GB}^T
B1
STATICS OF EFFECTOR PART
J_{EG}^T
E2
u_E
EFFECTOR THRUST
EFFECTOR THRUST CHARAC-TERISTIC
E1
GRAVITY OF MAIN BODY PART
M_B
B3
g_B
INERTIA OF MAIN BODY PART
M_B^{-1}
B2'
a_B
ACCELERATION OF MAIN BODY PART
INCLINATION ANGLE SENSOR G_{gBs}
ACCELERATION SENSOR G_{aBs}
g_{Bs}
a_{Bs}
VIRTUAL THRUST TRANSFER GATE
$J_{GB}^{-T} M_B$
G'
P COMPUTER
H
OPERATOR
TARGET POSITION /VELOCITY TRAJECTORY
DIFFERENTIAL CALCULUS
P1
TARGET ACCELERATION TRAJECTORY
a_{Bd}
THRUST PLANNING PART
P2
u_{Gvd}
TARGET THRUST AT THRUST TRANSFER GATE
u_{Ed}
EFFECTOR THRUST COMMAND
THRUST CONTROL PART
P3
$\hat{u}_{Gv}$
ESTIMATED THRUST VALUE AT VIRTUAL THRUST TRANSFER GATE

Fig. 6

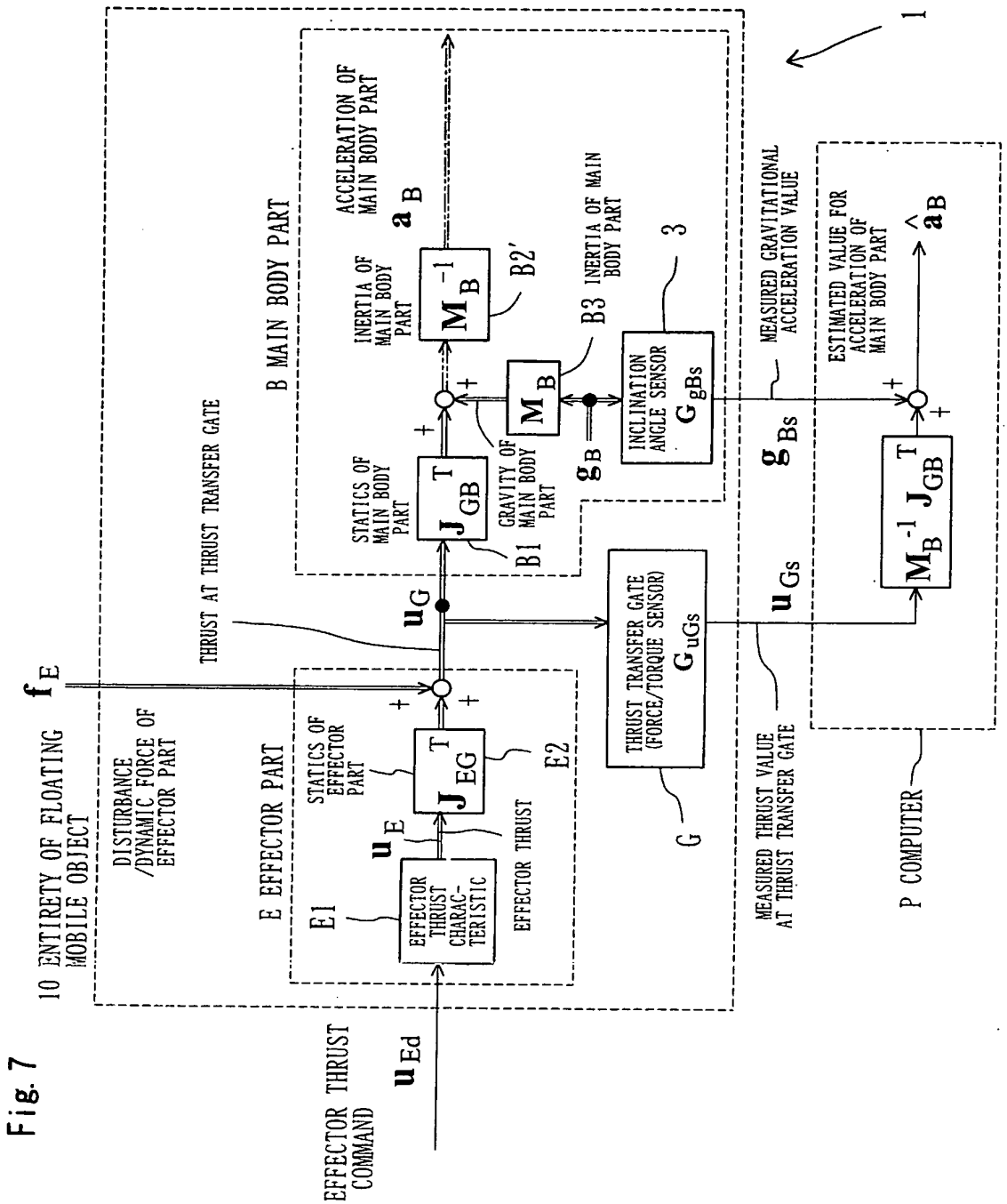

1
10 ENTIRETY OF FLOATING MOBILE OBJECT
DISTURBANCE /DYNAMIC FORCE OF EFFECTOR PART
$\mathbf{f}_E$
THRUST AT THRUST TRANSFER GATE
B MAIN BODY PART
ACCELERATION OF MAIN BODY PART
$\mathbf{a}_B$
INERTIA OF MAIN BODY PART
$\mathbf{M}_B^{-1}$
B2'
B3 INERTIA OF MAIN BODY PART
$\mathbf{M}_B$
3
INCLINATION ANGLE SENSOR
$\mathbf{G}_{gBs}$
MEASURED GRAVITATIONAL ACCELERATION VALUE
$\mathbf{g}_{Bs}$
ESTIMATED VALUE FOR ACCELERATION OF MAIN BODY PART
$\hat{\mathbf{a}}_B$
STATICS OF MAIN BODY PART
$\mathbf{J}_{GB}^T$
B1
GRAVITY OF MAIN BODY PART
$\mathbf{g}_B$
$\mathbf{u}_G$
THRUST TRANSFER GATE (FORCE/TORQUE SENSOR)
$\mathbf{G}_{uGs}$
G
$\mathbf{u}_{Gs}$
$\mathbf{M}_B^{-1}\mathbf{J}_{GB}^T$
E EFFECTOR PART
E1
EFFECTOR THRUST CHARAC-TERISTIC
$\mathbf{u}_E$
STATICS OF EFFECTOR PART
$\mathbf{J}_{EG}^T$
E2
EFFECTOR THRUST
MEASURED THRUST VALUE AT THRUST TRANSFER GATE
P COMPUTER
EFFECTOR THRUST COMMAND
$\mathbf{u}_{Ed}$

Fig. 7

Fig. 8

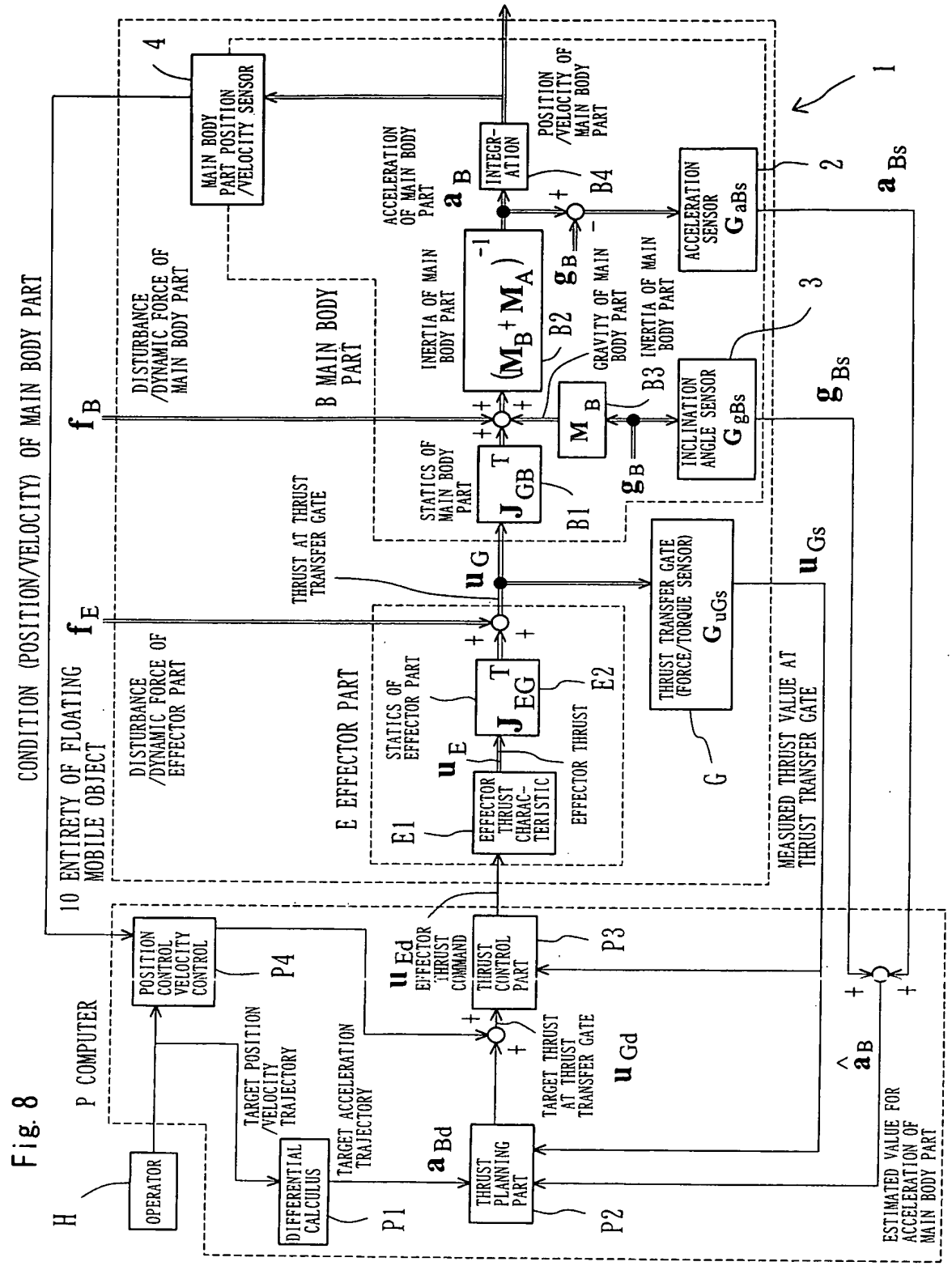

CONDITION (POSITION/VELOCITY) OF MAIN BODY PART
10 ENTIRETY OF FLOATING MOBILE OBJECT
DISTURBANCE /DYNAMIC FORCE OF EFFECTOR PART
E EFFECTOR PART
STATICS OF EFFECTOR PART
EFFECTOR THRUST CHARAC-TERISTIC
EFFECTOR THRUST
THRUST AT THRUST TRANSFER GATE
DISTURBANCE /DYNAMIC FORCE OF MAIN BODY PART
B MAIN BODY PART
STATICS OF MAIN BODY PART
INERTIA OF MAIN BODY PART
GRAVITY OF MAIN BODY PART
INERTIA OF MAIN BODY PART
MAIN BODY PART POSITION /VELOCITY SENSOR
ACCELERATION OF MAIN BODY PART
INTEGR-ATION
POSITION /VELOCITY OF MAIN BODY PART
ACCELERATION SENSOR
INCLINATION ANGLE SENSOR
THRUST TRANSFER GATE (FORCE/TORQUE SENSOR)
MEASURED THRUST VALUE AT THRUST TRANSFER GATE
P COMPUTER
OPERATOR
POSITION CONTROL VELOCITY CONTROL
DIFFERENTIAL CALCULUS
TARGET POSITION /VELOCITY TRAJECTORY
TARGET ACCELERATION TRAJECTORY
THRUST PLANNING PART
TARGET THRUST AT THRUST TRANSFER GATE
EFFECTOR THRUST COMMAND
THRUST CONTROL PART
ESTIMATED VALUE FOR ACCELERATION OF MAIN BODY PART
H
P1
P2
P3
P4
E1
E2
B1
B2
B3
B4
G
1
2
3
4

Fig. 9

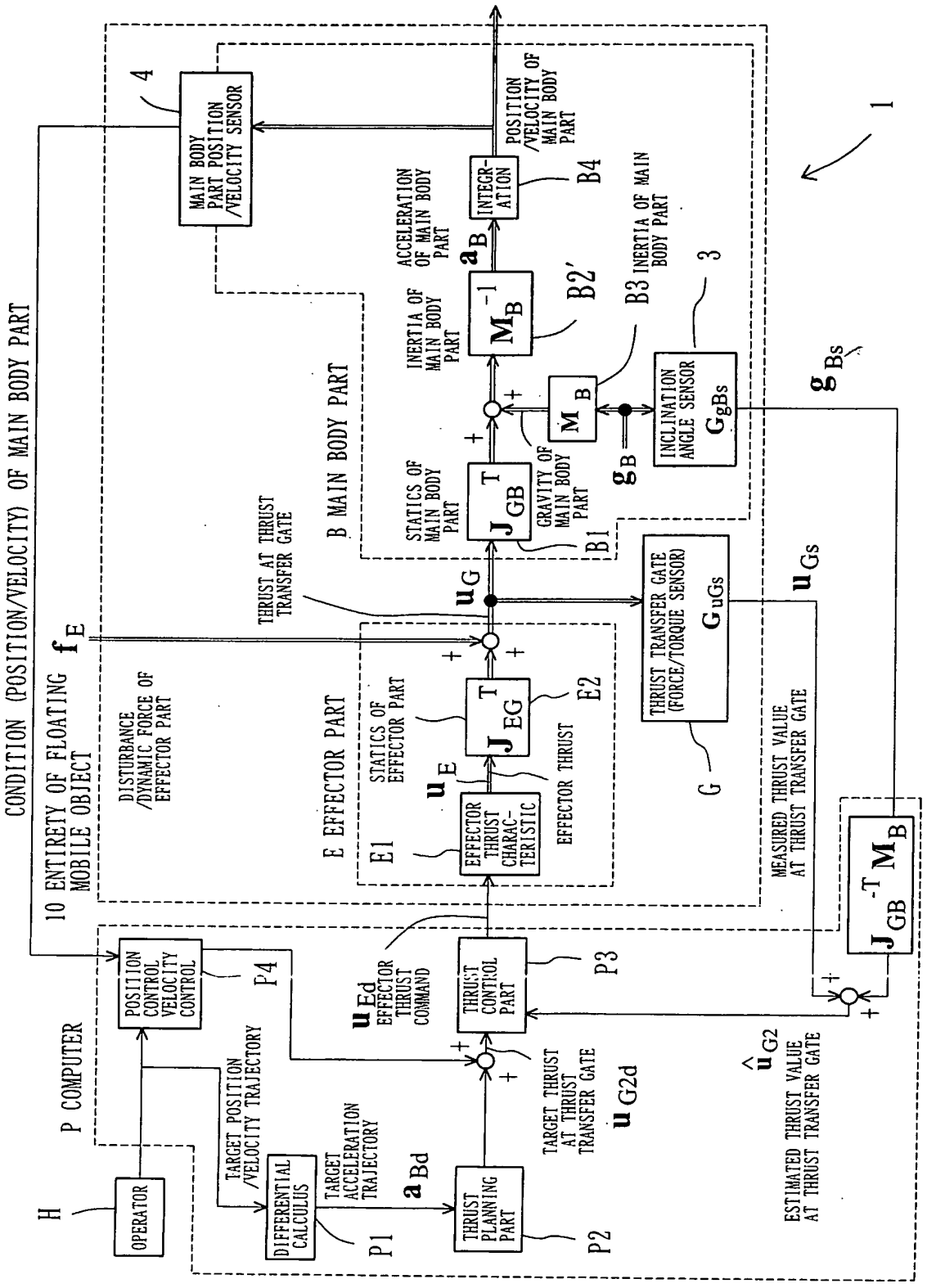

1
10 ENTIRETY OF FLOATING MOBILE OBJECT
CONDITION (POSITION/VELOCITY) OF MAIN BODY PART
4
MAIN BODY PART POSITION /VELOCITY SENSOR
POSITION /VELOCITY OF MAIN BODY PART
INTEGR-ATION
B4
ACCELERATION OF MAIN BODY PART
INERTIA OF MAIN BODY PART
B2'
B3 INERTIA OF MAIN BODY PART
3
INCLINATION ANGLE SENSOR
STATICS OF MAIN BODY PART
GRAVITY OF MAIN BODY PART
B1
B MAIN BODY PART
THRUST AT THRUST TRANSFER GATE
THRUST TRANSFER GATE (FORCE/TORQUE SENSOR)
DISTURBANCE /DYNAMIC FORCE OF EFFECTOR PART
E EFFECTOR PART
STATICS OF EFFECTOR PART
E1
E2
EFFECTOR THRUST CHARAC-TERISTIC
EFFECTOR THRUST
G
MEASURED THRUST VALUE AT THRUST TRANSFER GATE
P COMPUTER
POSITION CONTROL VELOCITY CONTROL
P4
THRUST CONTROL PART
P3
EFFECTOR THRUST COMMAND
TARGET POSITION /VELOCITY TRAJECTORY
TARGET ACCELERATION TRAJECTORY
DIFFERENTIAL CALCULUS
P1
THRUST PLANNING PART
P2
TARGET THRUST AT THRUST TRANSFER GATE
ESTIMATED THRUST VALUE AT THRUST TRANSFER GATE
H
OPERATOR

Fig. 10

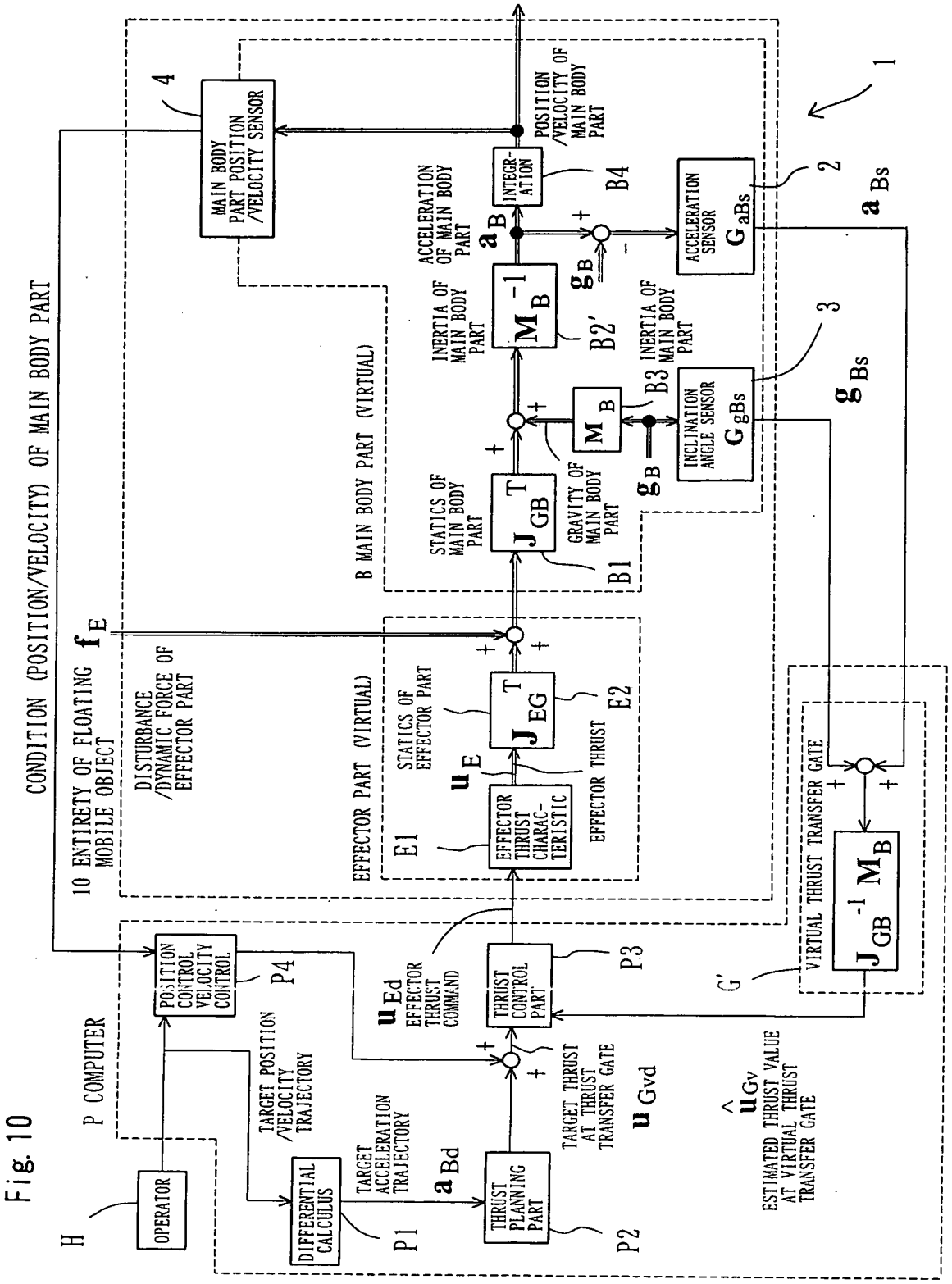

H
OPERATOR
P COMPUTER
P1
DIFFERENTIAL CALCULUS
TARGET ACCELERATION TRAJECTORY
a_{Bd}
TARGET POSITION /VELOCITY TRAJECTORY
P2
THRUST PLANNING PART
TARGET THRUST AT THRUST TRANSFER GATE
u_{Gvd}
P3
THRUST CONTROL PART
u_{Ed} EFFECTOR THRUST COMMAND
P4
POSITION CONTROL VELOCITY CONTROL
ESTIMATED THRUST VALUE AT VIRTUAL THRUST TRANSFER GATE
$\hat{u}_{Gv}$
G'
VIRTUAL THRUST TRANSFER GATE
$J_{GB}^{-1} M_B$
10 ENTIRETY OF FLOATING MOBILE OBJECT
CONDITION (POSITION/VELOCITY) OF MAIN BODY PART
DISTURBANCE /DYNAMIC FORCE OF EFFECTOR PART
f_E
EFFECTOR PART (VIRTUAL)
E1
EFFECTOR THRUST CHARAC-TERISTIC
u_E
STATICS OF EFFECTOR PART
J_{EG}^T
E2
EFFECTOR THRUST
B MAIN BODY PART (VIRTUAL)
STATICS OF MAIN BODY PART
J_{GB}^T
B1
GRAVITY OF MAIN BODY PART
g_B
M_B
B3
INERTIA OF MAIN BODY PART
INCLINATION ANGLE SENSOR G_{gBs}
3
g_{Bs}
INERTIA OF MAIN BODY PART
M_B^{-1}
B2'
ACCELERATION OF MAIN BODY PART
a_B
ACCELERATION SENSOR G_{aBs}
2
a_{Bs}
INTEGR-ATION
B4
POSITION /VELOCITY OF MAIN BODY PART
MAIN BODY PART POSITION /VELOCITY SENSOR
4
1

Fig. 11

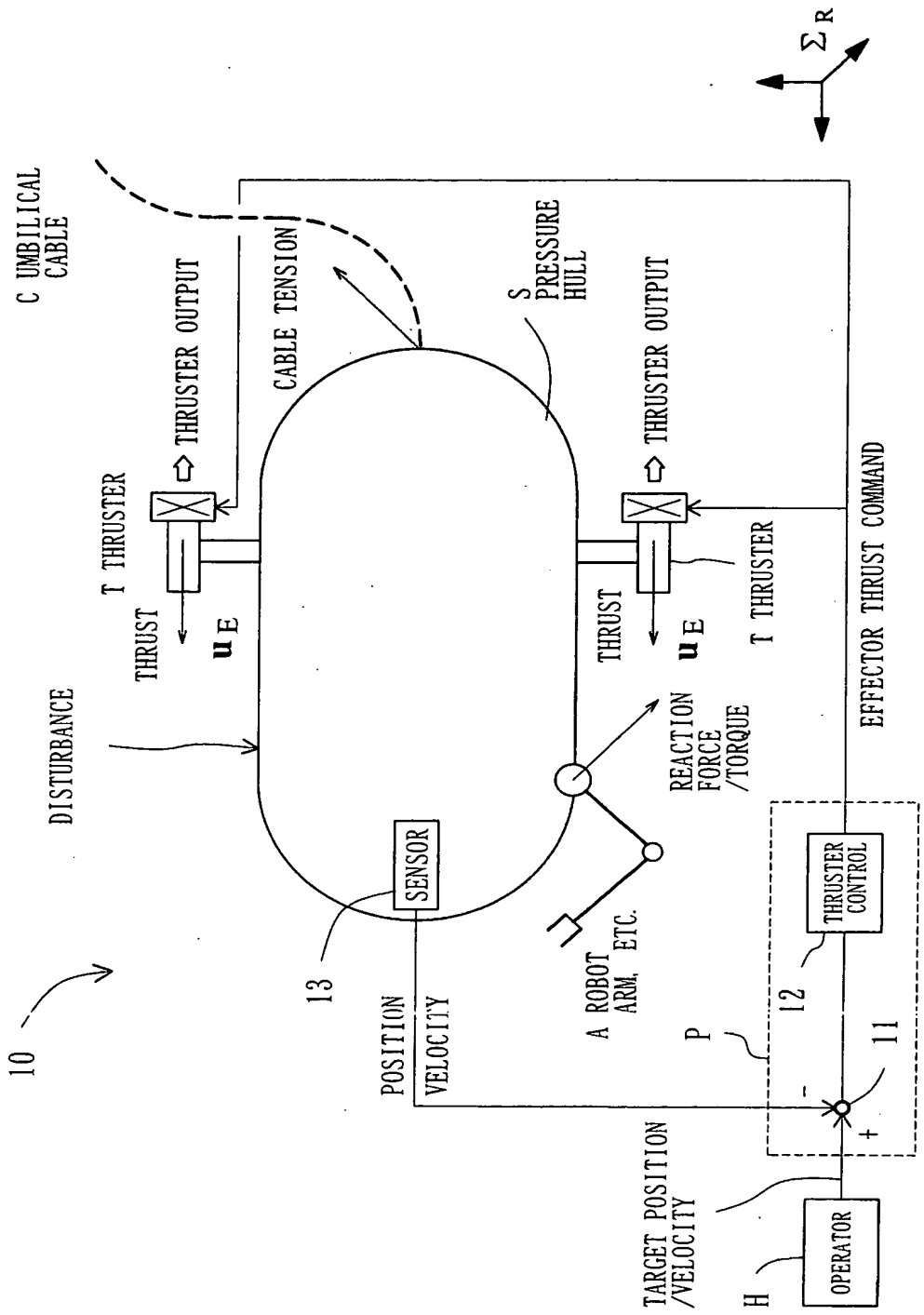

Σ R
C UMBILICAL CABLE
CABLE TENSION
S PRESSURE HULL
THRUSTER OUTPUT
THRUSTER OUTPUT
T THRUSTER
THRUST
u E
T THRUSTER
THRUST
u E
EFFECTOR THRUST COMMAND
DISTURBANCE
REACTION FORCE /TORQUE
SENSOR
THRUSTER CONTROL
13
A ROBOT ARM, ETC.
12
10
POSITION
VELOCITY
P
11
-
+
TARGET POSITION /VELOCITY
H
OPERATOR

Fig. 12

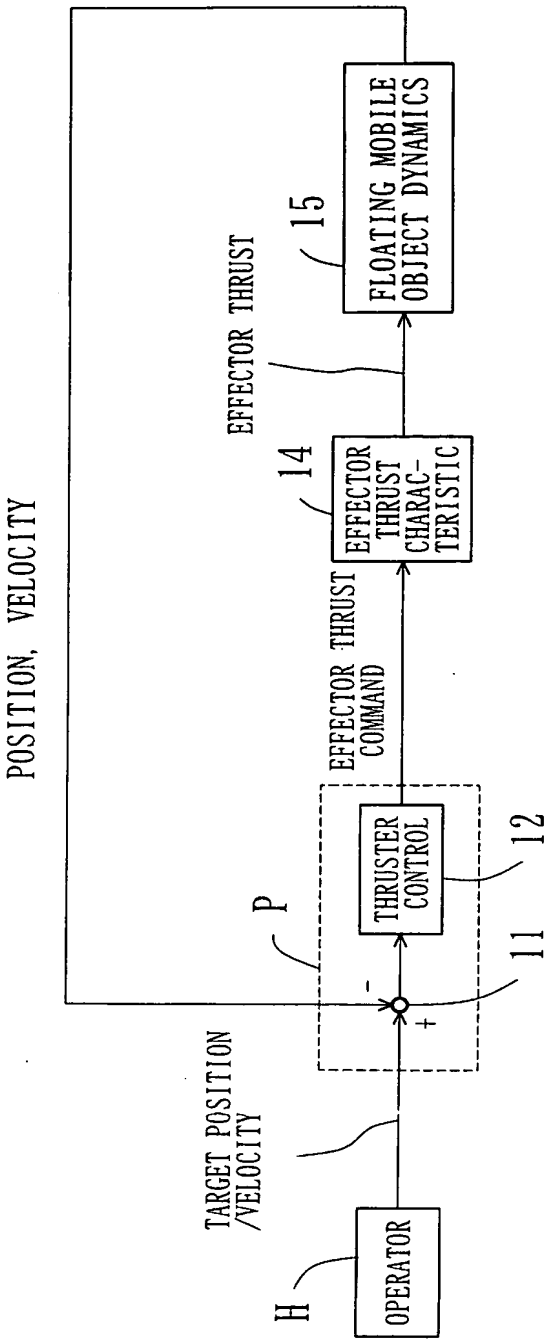

OPERATOR
H
TARGET POSITION /VELOCITY
THRUSTER CONTROL
12
EFFECTOR THRUST COMMAND
EFFECTOR THRUST CHARAC-TERISTIC
14
EFFECTOR THRUST
FLOATING MOBILE OBJECT DYNAMICS
15
POSITION, VELOCITY
P
11
-
+

Fig. 13

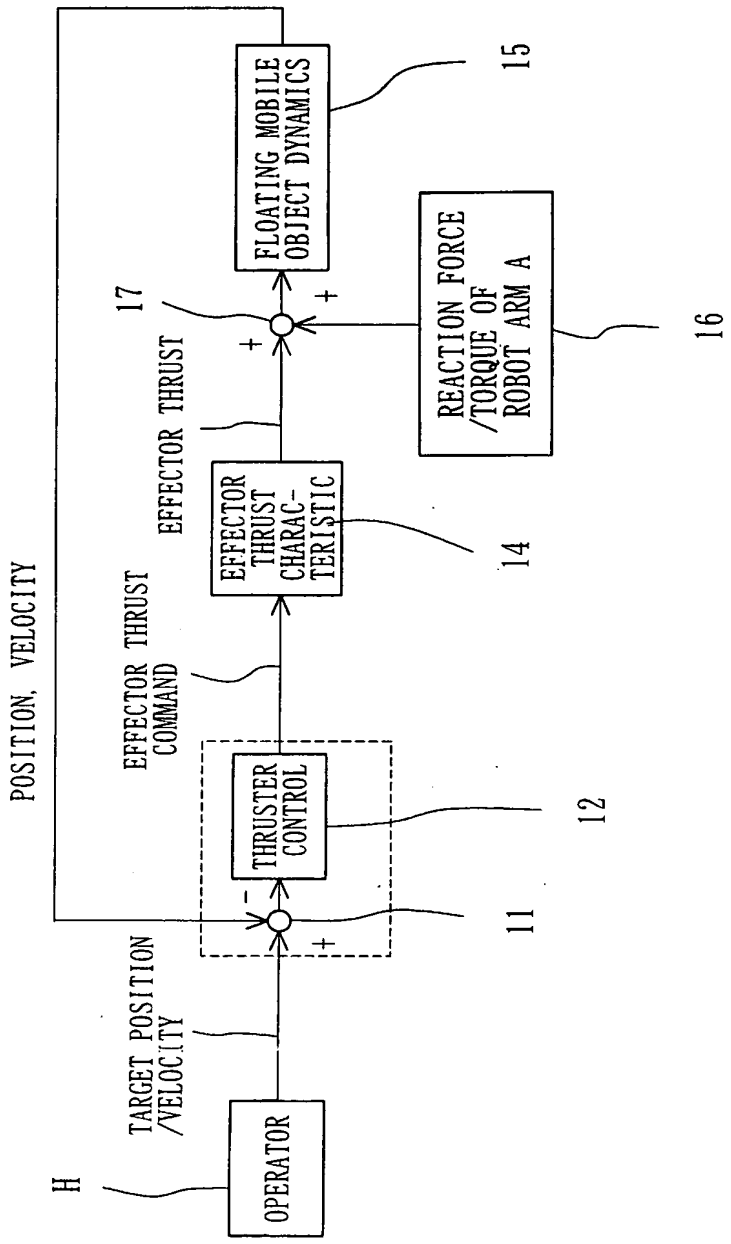
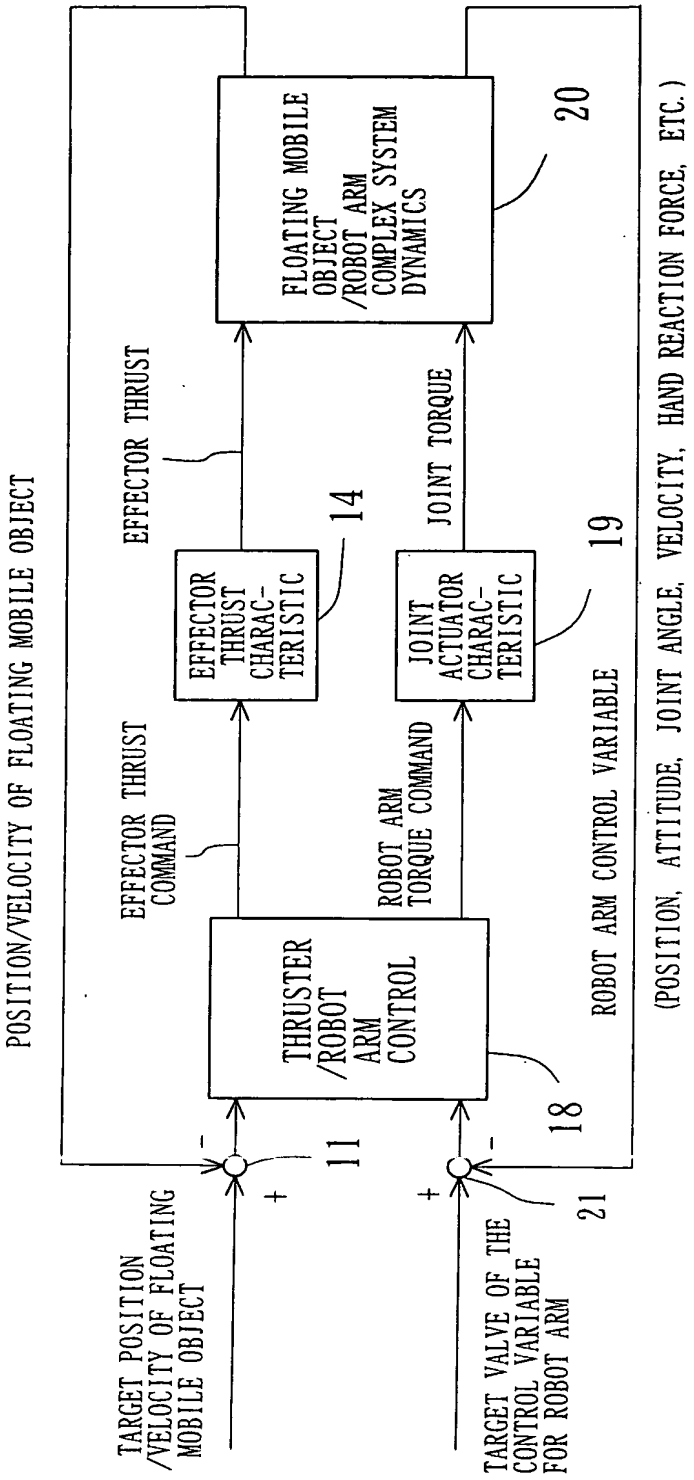

H
OPERATOR
TARGET POSITION /VELOCITY
11
THRUSTER CONTROL
12
EFFECTOR THRUST COMMAND
EFFECTOR THRUST CHARAC-TERISTIC
14
EFFECTOR THRUST
17
REACTION FORCE /TORQUE OF ROBOT ARM A
16
FLOATING MOBILE OBJECT DYNAMICS
15
POSITION, VELOCITY
+
-

Fig. 14


TARGET POSITION /VELOCITY OF FLOATING MOBILE OBJECT
TARGET VALVE OF THE CONTROL VARIABLE FOR ROBOT ARM
THRUSTER /ROBOT ARM CONTROL
11
18
21
EFFECTOR THRUST COMMAND
ROBOT ARM TORQUE COMMAND
EFFECTOR THRUST CHARAC-TERISTIC
JOINT ACTUATOR CHARAC-TERISTIC
14
19
EFFECTOR THRUST
JOINT TORQUE
FLOATING MOBILE OBJECT /ROBOT ARM COMPLEX SYSTEM DYNAMICS
20
POSITION/VELOCITY OF FLOATING MOBILE OBJECT
ROBOT ARM CONTROL VARIABLE
(POSITION, ATTITUDE, JOINT ANGLE, VELOCITY, HAND REACTION FORCE, ETC.)